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THE GEOGRAPHY OF TENNESSEE

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TENNESSEE is the child of North Carolina and Virginia. Her northern and southern boundaries are inherited lines from colonial land grants given by Charles II. The rugged Unaka Mountains, the western range of the Blue Ridge, are the barrier on the crest of which is the eastern boundary; the western limit of the state is determined by the Mississippi River. This stream was a route offering easy access to the early explorers, among whom were DeSoto in 1541 and LaSalle in 1682. The Unaka Mountains were such a difficult barrier that the early settlers in the state felt so isolated from their homes in North Carolina and Virginia, that they formed the state of Franklin and, for the purpose of protecting their trade upon the Mississippi, even considered casting in their lot with a foreign country. In consequence of these early ambitions, Tennessee was admitted as a state in 1796 with its capital located at Knoxville. The early settlement of the state was due to its rivers, which were a means of easy transportation reaching back to the gaps in the mountains; also the early quieting of Indian claims had a considerable share in rendering the land safe to the pioneer. Tennessee was the route across which moved a great stream of settlers for other states, and in this manner became a "mother of states." It has been the home of three Presidents: Jackson, Polk, and Johnson. Many southern statesmen claim Tennessee as their native state, and in the Civil War it was a battlefield second in importance only to Virginia.

The state includes a portion of nearly all the great physiographic regions east of the Mississippi River. The hard crystalline rocks along its eastern border form the highest mountains of the Appalachians; the folded limestones and shales have been deeply eroded to form the Great Valley; the horizontal sandstones constitute the Cumberland Plateau, west of which is the Central Basin and the western valley of the Tennessee River; and the extreme western portion of the state is a low plateau, the bluff of which overlooks the alluvial plain of the Mississippi.

These eight distinct physical regions of Tennessee have influenced or controlled the occupations and industries of the state to such an extent that it seems best to describe them more in detail.

1. *The Unaka Mountains*

These granite mountains are the most massive of the Appalachian Highland and in their parallel ranges on the eastern border of the state are the high, well-rounded domes of Mt. Mitchell and Mt. Guyot. These mountains are the base upon which was deposited the series of sedimentary rocks from which

the features of other portions of the state have been eroded. The long continued erosion has entirely removed the former covering of sedimentary rocks, and now the granite core forms the well weathered slopes of the Unakas. These smooth, waste-covered slopes are heavily forested nearly to the grassy "bald" at their summit. Where the tributaries of the Tennessee cross these mountains occur deep, rugged valleys occupied by railroad lines and highways.

2. *The Valley of East Tennessee*

This portion of the Great Valley was eroded from layers of sedimentary rocks which have been greatly folded and faulted. This long valley is about sixty miles wide from the Cumberland Gap to the edge of the Unakas, while farther south in the vicinity of Chattanooga it is less than forty miles in width. The western edge of this great valley is determined by the almost continuous escarpment of the Cumberland Plateau, Walden Ridge, which stands about 1000 feet above the general level of the valley floor. On the floor of this valley are low longitudinal ridges which are the most continuous and the highest in its western half, while in the eastern portion the ridges are much smaller and less continuous. These ridges determine in a very striking manner the course of the minor streams and the lines of traffic. The Tennessee, flowing southwest, is the master stream; the southern half of its course is at the foot of Walden Ridge which position it has attained by cutting across the longitudinal ridges from Knoxville to Kingston. The Clinch, Holstein, and French Broad are its tributaries from the northeast, while the Hiwasse is a transverse branch from the southeast. The latter stream has many creeks, joining it at right angles from the valleys or "coves" between the main ridges. Near Chattanooga the Tennessee River turns sharply upon its course in the famous "Moccasin Bend" and passes into the deep, steep-sided gorge which it has cut into the Cumberland Plateau. It has been suggested that this course of the Tennessee is the deeply intrenched course of the ancient river.

3. *The Cumberland Plateau*

This region, often incorrectly called the Cumberland Mountains, is a smooth tableland except along its ragged western edge and the steep, irregular face overlooking the Great Valley. The bed rock is a horizontal sandstone which bears the coal measures of the state. The land is wooded with scrub oak and the lean soil derived from the underlying sandstone is ill adapted to agriculture.

4. *The Highlands and the Basin of Middle Tennessee*

The central portion of the state is a saucer-like depression, the deep portion of which is the Central Basin while the broad rim is the Highland Region or Rim. The Central Basin is 300 to 400 feet lower than the Rim, and its surface is gently rolling with here and there a small unconsumed rocky hill. The Basin has outlets cut in its rim by the Duck, Elk, and Cumberland rivers. The rich soil has been weathered from the underlying blue limestone, and it is the richest agricultural region in the state. It is a "Blue Grass" region as

fertile as the more famous one of Kentucky. This "Dimple of Tennessee" supports the largest part of the population of the state. Nashville, which is situated on the southern-most bend of the Cumberland river, is in a low part of the Central Basin. The Rim of Highlands consists of barrens along the edge of the Basin. Back from the edge is a belt of fertile red soil, while throughout the Highlands limestone sinks are widely distributed, and caves frequently occur.

5. *The Western Valley of the Tennessee*

The Tennessee in its northern course across the state has entrenched itself in a deep and narrow valley, less than ten miles wide and nearly 500 feet below the general surface. Excellent soils occur in the narrow bottom lands, and the stream is a highway for river traffic.

6. *Uplands of Western Tennessee*

The lands slope gradually from the valley of the Tennessee to the bottom-lands of the Mississippi. The "Bluff" edge of these uplands overlooks the broad flood plain of the Mississippi, and where the river reaches the base of the bluff, there is a natural site for a landing place and a trading city. The light sandy soils are formed from the soft Cretaceous and Tertiary bed rock. The bluff loess is a broad belt 20 to 30 miles wide in the western half of this region, and undoubtedly owes its origin to the fine alluvium carried by the wind from the bottom lands to the bluff.

7. *The Mississippi Bottom Lands*

Along the western border of the state are the low swampy bottom-lands of the Mississippi flood plain, which are not over 215 feet above the Gulf of Mexico. It is the smallest of the natural provinces of the state, and it has its greatest width in the Reelfoot Lake district at the northwestern corner of the state. This latter region is of considerable interest as it was not in existence before the earthquake of 1811-12. This disturbance dammed up the old course of Reelfoot River forming a lake 18 miles long and three miles wide.

Climate, Soil and Agriculture

Climate.—The climate within the state is considerably modified by the range in elevation from 200 feet above sea in the Western bottom-lands to 5,000 feet in places in the Unaka Range. The average annual temperature for places in the latter range is 45 degrees and for the bottom-lands 61 degrees. The length of the growing season, or the season between killing frosts, is of the greatest importance where agriculture is the chief occupation. The growing season ranges from 180 days to 200 days. In some sections of the state a wheat and corn crop may be taken from the same soil each season. The total precipitation is nearly 50 inches, and the months of the growing season receive the most rain, while fall droughts are common. In 1913 Nashville had 261 days with no measurable fall of rain. Snowfalls are light and remain only a few days. Low temperatures are rare and of short duration; in conse-

quence, pastures are green throughout the year, and stock does not require much shelter. High temperatures are common in summer, and the periods of excessive heat frequently prevail for two weeks. At Nashville in 1914, there were five days when the temperature was 100 degrees or over.

Soil.—The soils of Tennessee are largely residual and are closely related to the geological formations of each section of the state. The Appalachian Mountains on the eastern border are covered with gentle slopes of waste formed from the long weathering of the granites and metamorphic rocks. The rich and fertile soils derived from limestone and shale cover the largest area of the state, being confined to the Great Valley, the Highland Rim, and the Central Basin. The sandstone of the Cumberland Plateau forms the poorest soils and, in consequence, the farm values in Cumberland, Morgan, and Fentress counties are low, ranging from four to seven dollars an acre. The loessial soils in the western portion of the state are easily worked and especially adapted to cotton. The rich bottom-land along the Mississippi River where it has been well drained is highly productive. About one-half of the state is improved farmland, and in this respect Tennessee ranks first in the southern states.

Crops.—Corn, cotton, wheat, tobacco, and hay are the five important staple crops of the state. Tennessee is an ideal corn country, especially the shale and limestone soils of the Central Basin and the Great Valley. The largest production is in the counties of Maury, Giles, Rutherford, and Gibson. The corn patch is an essential part of every farm, and it enters largely into the people's food. This is the home of johnny cake, corn dodger, hoe cake, and other forms of corn bread. Cotton is the second crop in value and its production is confined largely to the southwestern part of the state, especially Shelby and Fayette counties. The acreage devoted to cotton has not increased as rapidly as that of some other crops for there has been an active and state-wide campaign to discourage the one crop system, and this has resulted in mixed farming. Wheat ranks third in value as a state crop, and the Central Basin is the chief region for its production. The hay and forage crops are fourth in the agricultural products of the state. Timothy and red top are important as fodder, whiie blue grass is the chief pasture in the Central Basin and the Great Valley. Clover, soy beans, cowpeas, and alfalfa are being increasingly used on lands worn-out under one-cropping. Tobacco is among the five great crops of the state, and in the annual value of this crop, Tennessee ranks fifth in the country. The dark tobacco is raised most extensively in Montgomery, Robertson, and Weakly counties. This district belongs to the black tobacco region of Kentucky, and much of the product is shipped through London and Liverpool to be consumed in Belgium, Italy, and some of the western Asiatic countries.

Outside of the staple crops, Tennessee has some special agricultural products worthy of mention. The peanut belt is in the western valley, and sweet potatoes are widely grown throughout the entire state. In the growing and

marketing of strawberries for the northern markets, the state ranks first in the South. It is one of the leading states in egg production and turkey raising. It ranks second in the growing of sorghum cane for the home manufacture of "long sweetening."

The state possesses excellent climatic advantages for stock raising in the long out-door grazing season and the mild winter. The corn crop is turned into pork, and the hog ranks fourth among the domestic animals. The horse is the most important of the farm animals for work and for breeding. On the famous stock farms, such as the "Belle Meade" near Nashville, have been bred some of the fastest running and harness horses in the world. In the breeding of the finer types of mules Tennessee excels, and a large number of these useful draft animals are exported to European countries.

The per capita farm wealth is $380, as compared with $1380 for Wisconsin and $2695 for Illinois. This is due in part to the Civil War which completely disorganized all lines of business, and still more to the influence of the one crop, farm tenancy, and supply merchant system. It is stated by careful investigators that "the production of food stuffs in Tennessee ($65 per capita) does not provide enough bread and meat for its people." Only about one-third of the counties are self-supporting in their production of food stuffs. It is further stated that "the state spends 39 millions of dollars for hog and hominy which is imported from other states and could be raised at home." The per capita wealth of Tennessee's farm population by counties ranges from $97 in Polk County to $703 in Williamson. The rough lands of Polk County are unsuited to agriculture and most of its people are engaged in copper mining. In Williamson, the soils are rich; there are nearby markets in Nashville easily reached by good "pikes"; its farmers practice the many crop, live-stock ownership system.

Mineral Resources

Tennessee has a wide range in its mineral resources for its rock formations extend from the oldest granites to the latest river formations. Its 200 soft coal mines are chiefly in the Cumberland Plateau, in the counties of Campbell and Claiborne, and yield annually about seven million tons. The three iron ore fields are closely associated with the coal deposits and yield each year about three-quarters of a million tons of ore which is consumed in the 24 iron furnaces of the state. The rich phosphate beds are widely distributed in Middle Tennessee, from which nearly half a million tons are annually mined, giving the state second rank in this product. Columbia is the chief center for the preparation of the phosphate fertilizer for market. The hard crystalline rocks of Polk County have rich deposits of copper which are mined chiefly in the vicinity of Ducktown; this is the second largest copper producing center east of the Mississippi. Fine kaolin occurs near Sparta, high grade china and pottery clays are mined in Fayette, Henry, and Carrol counties. Large amounts of the high grade clays are shipped to East Liverpool, Ohio, for chinaware. The shales of the coal measures are being used to some extent for brick, sewer pipe,

and paving blocks. The quarries of Knox County yield the famous Tennessee marble which is widely used for interior decorating and finishing. The Parian white, black, blue, brown, and pink are some of the shades of these marbles quarried near Knoxville.

Forests

The forests of Tennessee are rich in the hardwoods and their distribution is closely related to the soils of the different regions. In the Central Basin, where the soil is largely a decomposed limestone, rich in plant food, the natural forests were black walnut, hickory, beech, tulip, and hackberry. The lean soil of the Cumberland Plateau produces a scrub oak which is the source of much of the present oak lumber, some pine, and some hemlock. On the rich western bottom lands are the cottonwood, the bald cypress, and the live oak. Oak, maple, walnut, and hickory are the chief forest growth on the flanks of the Unaka and in the Great Valley. Tennessee is the leading state in the production of hickory, oak, and yellow poplar. The forests have been very rapidly removed since the Civil War and in many places great injury has been done to the soil.

Water Power

The state of Tennessee possesses a valuable resource in its waterpower and hydraulic engineers estimate that only one-tenth of the available power is developed. The greater development of the waterpower began in 1912 when long distance transmission lines were completed and hydro-electric machinery installed. During the above year seven turbines with 29,000 horse power were installed. In 1913 fourteen more were added with a total capacity of 63,000 horse power which makes the total development of the state close to 190,000 horse power. At Hale's Bar on the Tennessee River, four more turbines are soon to be installed, and during 1914 construction was commenced on a plant of 80,000 horse-power on the Little Tennessee River. The developments at Hale's Bar, which is 21 miles from Chattanooga, comprise a dam 40 feet high, and 2500 feet long and a large lock chamber to provide for the navigation of the river. The Ocoee River plants near Parksville, some 48 miles from Chattanooga, combined with the above plant provide abundant power for industrial purposes in Chattanooga and the surrounding region. It is estimated by the Tennessee Geological Survey that "probably more waterpower is within fifty miles of Chattanooga than Niagara Falls." Transmission lines already extend from Hale's Bar and Parksville to Cleveland and Knoxville. Other lines are surveyed and under construction to Nashville, Bristol, Johnson City, Greenville, and Elizabethton.

Manufactures

The natural resources of iron, coal, clay, and limestone are located so as to give some advantages in the industries whose raw materials are the minerals. The hardwood forests are widely distributed and they are utilized for the hardwood lumber that enters into the furniture, vehicle, interior finishing,

and veneer woods. Transportation by the Cumberland, the Tennessee, and the Mississippi reaches all parts of the state while the railroad lines comprise several important trunk lines. The output of manufactured products reflects fairly well the natural resources with the exception of the printing business. In printing Tennessee is the leading southern state east of the Mississippi and owes its advantages in this line to the energy and ability of the founders. In total value of manufactured products, the state ranks twenty-sixth and among the southern states its products ranked sixth in value in 1904.

Population and Cities

The state is seventeenth in population, this in numbers is about the same as the city of Chicago. In 1840-50 the state held fifth rank in population for it received and held a large portion of the western immigration. Some of its counties are laid out in circular form, especially White, Warren, and Overton. This peculiar outline was determined by early grants which included all the land within a given distance of some point. Shelby county has the largest area which is nearly eight times as large as that of the smallest one, Trousdale. The average density of population is 52 persons per square mile, and the region of greatest density is Davidson, Shelby, and Hamilton counties which include the largest cities of the state.

The composition of the population is quite remarkable in almost a complete absence of the foreign element. The negro forms about one-quarter of the total population, and of the colored people about one-fourth are mulatto. The latter, according to the thirteenth census, are increasing which adds complexity to the southern social problem. The negro forms a small part of population in the Cumberland Plateau counties, especially the more remote and inaccessible ones. Pickett county in the northern Cumberland region has only eleven negroes and no foreign-born element. Its people are the typical southern highlanders among whom survive an eighteenth century English, the spinning wheel, the bee "gum" and a religious belief unsullied by modern interpretations. These surviving customs are due almost entirely to the geographical control exercised by the inaccessible surface features, and the lack of minerals and of suitable and sufficient land for cultivation. The negro constitutes seventy-five per cent of the population in Fayette County, for its fertile soils produce the major part of the state's cotton, and the negro is the chief laborer in the cotton fields.

Tennessee is largely an agricultural state for close to eighty per cent of its people are on the farm and in small villages. The modern movement of people to the large cities is indicated by the thirty per cent increase in its urban population since 1900, while the same period shows that the rural population has increased only three per cent. Four cities of the state, each with a population of more than 35,000 people, have developed at points possessing marked advantages in manufacturing and transportation.

Memphis possesses commercial advantages in both river and rail transportation. It is sometimes called the "Bluff City" from its location on the bluffs

overlooking the flood plains of the Mississippi. The advantage of its site for a trading center was recognized by the French as early as 1732, when Fort Assumption was built here, and became one of the strongholds in the French line of forts across the country. The interests of the city before the Civil War were largely commercial, but in the modern industrial development it has grown into the first manufacturing center of the state and the leading city in population. Its rapid expansion has resulted largely from the advantageous position it affords railroads in crossing the Mississippi River, and, in consequence, a number of trunk lines are centered here. A large portion of the cotton crop of the Black Belt of Mississippi, Alabama, and Arkansas is brought to Memphis by railroad for shipment via the Mississippi River to New Orleans. The by-products of cotton raising, the seeds, follow the crop to Memphis where there has developed an extensive cotton seed oil industry. Flour mills, lumber and timber, tobacco and food preparations are among the chief industries of the city whose geographical advantages will undoubtedly bring it a greater growth as the commerce of the Mississippi develops.

Nashville was founded as early as 1714 by Clarebville, a French trader, near a salt "lick" or spring that was much frequented by Indians who came to obtain salt. Around this French trading post, about 60 years after its establishment, and under the leadership of Robertson, the town of Nashborough, later changed to Nashville, grew rapidly. It is situated on the broadest flat at the southernmost bend of the Cumberland River. It was early the focus of Indian trails, and of the blazed trails and roads of early settlers, just as it is today a railroad center. The main portion of the city lies in this small basin on the river, and as it has expanded, portions now occupy large tracts on the surrounding heights. In the center of the flat is a prominent rock hill upon which stands the state capitol building; this is conspicuous throughout the city. Along a now abandoned course of the Cumberland River, the railroads have ample freight yards and a Union Depot in the heart of the city. The chief industries are flour milling, lumber and timber, printing, furniture and the preparation of fertilizers. The lumbering products are largely of the hardwoods which are obtained from the Cumberland Plateau.

Chattanooga in the Great Valley may be said to belong to three states, Tennessee, Georgia, and Alabama, for it stands near their junction. Its advantageous site on the Moccasin Bend of the Tennessee River was a camping ground for the Indians, later a trading post, a critical point in the Civil War, and at present it has large industrial interests. The site of the city was originally known as the "Landing" where voyagers would embark for up-river points and those going down stream would disembark to avoid the rapids below the city. Chattanooga, "the Gate City," is located in the southern end of the Great Valley, and near where it opens out to the wide coastal plains along the Gulf of Mexico. The floor of the Great Valley at this place is only 40 miles in width, and on it the Tennessee River is swinging in broad meanders, making a complete turn on its course and leaving the valley by a deep cut gorge

in the Cumberland Plateau. Missionary Ridge, one of the high longitudinal ridges in the valley, is parallel to the Tennessee River and passes a short distance to the east of the city. Its position makes it a vital part of the military key of this region, and caused it to be one of the most fiercely contested battle grounds of the Civil War. Lookout Mountain at the southern edge of the city rises 1500 feet above the river, and from its summit, which is reached by an incline railroad, a wonderful panoramic view of the Great Valley, Walden Ridge and the Unakas is obtained. Chattanooga lies in the heart of the coal regions with iron ore and limestone. Its chief manufacturing interests are concerned with assembling these raw materials and producing foundry and machine shop products. The richness of mineral deposits, their occurrence in such favorable conditions for mining and the minimum of transportation required are factors which will give this region great advantage in the future expansion of its iron ore industry. Chattanooga is near the center of the best hardwood timber of the South. Furniture factories, coffin works, box factories, wagon works, hardwood finish shops, and cooperage plants constitute some of the wood working industries which rank third in the city. Other important lines of industry are flour milling, food products, brewing, and tanning.

Knoxville is in the center of the Valley of East Tennessee; it was formerly the capital of the state and its position at the head of the Tennessee River and near the junction of the Holstein and French Broad rivers gave it importance in early river traffic. Its chief industries are the quarrying and preparation of marble for the market. The surrounding land is well adapted to farming and truck gardening. Early vegetables are raised in large quantities for the northern markets.

DIAGRAM-MAP OF WESTERN WAR ZONE

The March issue of the Bulletin of the American Geographical Society contains an article on "Geographic Aspects of the War," by Professor D. W. Johnson, illustrated by a block diagram of the western war zone. The topographic peculiarities of the Vosges and Ardennes Mountains, the plateau of western Germany cut by the gorges of the Rhine, Meuse and Moselle rivers, the cuesta escarpments of north-eastern France, and the principal valleys which have affected the campaign, are clearly represented. With the aid of this bird's-eye view of the entire western theatre of war one can readily trace the positions of the contending armies, and note many striking examples of the influence of landforms upon detailed movements of armies and general plans of campaign. Enlarged copies of the drawing, size about 29x17 inches, can be secured at a cost of fifty cents each by writing to the Columbia University Bookstore, New York City.

THE CASCADE MOUNTAINS*

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Location, Extent, Etc.

IN the western part of the Pacific States, trending parallel with the coast and extending from northern California northward beyond the United States-Canadian boundary, there is a lofty and extremely rugged belt of mountains known as the Cascade Range. The belt attains its greatest width, 100 miles, near the international boundary, and from there southward its east-west extent varies between 25 and 75 miles.

Until recent years, the term "Cascades" was applicable only as far south as the Oregon border. The Lassen Peak Ridge of northern California was then considered the northern termination of the Sierra Nevadas. Recent study has shown, however, that this ridge consists entirely of volcanic material, and therefore presents a marked contrast to the Sierras both in its rocks and in its manner of growth; while its volcanic origin is accepted as evidence that it should be considered the southern extension of the Cascades, noted for their immense development of igneous rocks.

Southern Cascades distinguished.—The mountains of the two northern states, as will be noted in the following pages, owe their existence primarily to uplift and dissection, while in the development of the Lassen Peak Ridge, uplift has played but a minor part. The piling up of lava and other ejecta about more than a hundred volcanic vents has given rise to this ridge. Owing to this great difference in the physiographic history of the two parts of the range, it is deemed best to consider them separately, and therefore, in this article, only that part of the range lying in Washington and Oregon and commonly known as the Cascades will be the subject of discussion.

Topographic Descriptions

Characteristic features.—Before going into detail concerning the history of this portion of the range and the forces to which it owes its existence, let us consider briefly the general topographic features that gradually suggest themselves upon crossing the mountainous tract and viewing the mountains from the summits of a number of peaks. At first the range seems "a puzzling complex of ridges and peaks," (I. C. Russell) but soon one is impressed with the general uniformity of altitude. One soon realizes that the Cascades are not a sharp-crested uplift, but a deeply dissected plateau, and that the sharp divide, which parts the eastward and westward flowing streams, is due to the headwater extension of the opposite flowing rivers.

Summary description.—For a generalized view of the northern and central Cascades, therefore, it is well to hold in mind as the leading topographic

*Prepared under the direction of Professor N. M. Fenneman.

feature an elongated, flat-topped dome, about 600 miles long, 40 to 100 miles wide, 8500 feet high near the international boundary, declining gradually to about 4000 feet near the Oregon border, its gently sloping sides merging with the lower regions adjacent on the east and west, its borders crenulated, and its summit crowned with a long line of volcanic peaks, all so completely dissected and sculptured by river and ice, as to produce the most beautiful mountain scenery the continent affords.

Northern subranges described.—The wildest and most picturesque scenery of the Cascade Mountains is found in the triple set of subranges in which the range terminates on the north. Here the mountains reach their greatest development. They rise to uniform elevations of 8500 to 9000 feet, into the region of perennial snows. The scenery is typically Alpine. The deep and complete dissection of these subranges is due to the rapid descent of the streams that leave the crest, and which, throughout the greater part of their length, flow through deep canyons, which at many places are so narrow as to barely permit the passage of the streams. Precipitous slopes prevail everywhere and much of the region is impassable even to prospectors. Between the canyons stand the sharp, serrate ridges with their high, jagged, pyramidal peaks. These "Matterhorn" peaks are the result not of stream erosion, but of the headward extension of the glaciers whose remnants, even now, linger in protected spots.

The main range.—The same rugged topography found along the northern border is continued in the main range and in the higher portions of the subranges found along the border as far south as Wenatchee. (Lat. 47°30′). These ridges represent secondary elevations whose trend is almost at right angles to the main range. Altitudes here vary from 4000 to 8000 feet. In the higher parts, dissection has attained maturity. The valleys are deep and canyon-like and the divides narrow. Sharp peaks and pinnacles, steep slopes ending in glacial amphitheatres, still occupied by glaciers, and wild, cascading streams are characteristic of this section of the range.

The southern half.—Farther to the south, the topography becomes more subdued. Elevations of 5000 to 6000 feet are reached near the divide, but out upon the flanks of the range, they rarely exceed 3000 feet. On the higher slopes, near the crest of the main range, where precipitation is comparatively great, erosion has been active and has produced rugged mountains, but out near the borders, where uplift was not so great and precipitation scanty, the ridges are broad and featureless in detail. The gulches that score the sides are barely noticeable in general view. The long, gentle slopes present an almost unbroken sweep from the broad, even-topped crests to the adjacent valley floors. Such scenery is typical of the east side of the Cascades in Oregon.

History

Geologic history.—The history of this great mountain range is an interesting one. Its birth probably dates back far in geologic history. The

events of greatest interest, however, occurred in comparatively recent geologic times and began with the great eruptions which completely covered northern California, with most of Oregon and Washington (as far north as the parallel 47°30′) with a series of lava sheets averaging, perhaps, 2000 feet in thickness. This period of igneous activity and base-leveling seems to have been followed by an epoch in which the lava sheets together with the region of older rocks north of the above mentioned parallel were uplifted, and it is to these mountain building movements that the Cascades owe their present elevation.

Character of uplift.—As has been noted, this uplift was not of a broad, general nature, resulting in a great, flat-topped anticline with gentle slopes, but was effected with local warpings along the margin, which resulted in the series of parallel ridges found along its borders. This complex warping was no doubt occasioned by north-south and east-west pressure brought to bear simultaneously upon the great block of the earth's crust involved.

River history.—Evidence that the main drainage lines of the region were established previous to the initiation of the present relief, is abundant. In Washington the Yakima River crosses not one, but several of the high, eastern subranges, in a deep canyon in which the original meanders of the stream are well preserved. The Skagit River crosses the higher portion of the main range near the Canadian boundary in one of the narrowest, deepest and wildest canyons of the continent, while the Columbia has not only maintained its course across the eastern subranges, but has cut its way through the Cascade Range cleaving it from summit to sealevel. The Frazer River of British Columbia and the Pitt River of northern California also pierce the main range on their way to the sea. That the courses of these streams were established upon the Cascade lowland cannot be doubted. Not only do they furnish conclusive evidence of the lowland ancestry of the Cascades, but they throw an important light upon the rate of uplift, showing that warping must have been effected at a rate which permitted these master streams to maintain their courses without change.

Partial cycles.—For a complete understanding of the sculpturing of the Cascades of today from this great, diastrophic plateau, it is necessary to trace, briefly, the various stages of its topographic development. Uplift inaugurated a new cycle of erosion, gave opportunity for new streams to form and intrench themselves. That warping was arrested and halted for a long period is indicated by the broad, open valleys with rounded intervening ridges produced during this time. This was followed by a renewal of uplift, upon which the streams, now rejuvenated, began cutting their channels deep into the uplifted mass. The canyons to which the Cascades owe their wild, rugged and picturesque beauty were carved during this epoch. The relative position of the features produced during these early stages can be seen very clearly in the Columbia Valley just north of Wenatchee. Here the valley consists of two

parts, a deep, inner canyon and a broad outer valley, which opens gradually onto the old plateau surface, above which rise the residual hills or monadnocks.

Glacial period.—The canyon cutting stage was brought to a close by a great climatic change which led to vast accumulations of snow in this region. There is abundant evidence that great glaciers formed in the elevated plateau region of the Cascades, from whence they flowed eastward and westward through previously excavated valleys. Though of great size, these were truly Alpine glaciers. The sharp peaks, the hundreds of amphitheatres with their precipitous walls, the many lakes, the U-shaped valleys, the deserted stream channels or coulees, the moraines, all are the result of this ice invasion.

Perhaps the most noteworthy feature in this connection is Lake Chelan, a narrow river-like sheet of water, 65 miles long, located on the east side of the Cascades in northern Washington. This lake is situated in the heart of the highest mountains and is fed by the glaciers lingering on their slopes. At its northern limit it is barely 2 miles wide and for many miles southward steeply sloping walls 5000 to 6000 feet high rise abruptly from the clear blue waters. Farther south, its width increases to three miles and the landscape becomes more subdued. Its surface is only 1079 feet above sea level, yet soundings have revealed depths of 1419 feet, showing that in such places the bed of the lake is 340 feet below sea level.

It is believed that in pre-glacial times, this great gash in the earth was a stream canyon of ordinary depth. Glacial effects in this vicinity testify that ice from an area of about 350 square miles, found its way into this narrow valley. It is to the concentration and corrosive action of this ice, known to have attained a thickness of 1000 to 5000 feet, that the marvelous depth of the valley is attributed.

As this glacier slowly melted back it left a terminal moraine across the entrance of the valley where Chelan City now stands. With its retreat came the gradual expansion of the lake, which now occupies the Chelan Valley.

Volcanic peaks.—In addition to the leading topographic feature due to uplift and dissection, there are the prominent individual ice-capped peaks that rise far above the dark, coniferous forests and add so much to the scenery of this region. Some of these, like Mt. Stuart, are monadnocks, remnants upon an older topographic surface, but the long line of individual peaks found along the summit of the range is of volcanic origin. Enumerating them in order from north to south the principal ones are: Mt. Baker, 10877 ft.; Glacier Peak, 10436 ft.; Mt. Rainier, 14525 ft.; Mt. St. Helens, 9750 ft.; Mt. Adams, 9570 ft., in Washington, and Mt. Hood, 11225 ft., Mt. Jefferson, 10220 ft., Mt. Mazama, 8220 ft., and Mt. Pitt, 9760 ft., in Oregon. These peaks, it is thought came into existence after the time of uplift, and are therefore, of later date than the range itself. All were built by the accumulation of viscous lavas, volcanic ash and other ejecta about old centers of volcanic disturbance.

The most unique of these is Mt. Mazama, of southern Oregon. This mountain represents a truncated cone in the top of which there is an immense depression now occupied by the waters of Crater Lake. The almost vertical cliffs which surround it rise to elevations of 2000 ft., and the maximum depth of the lake is almost as great. It is believed that this peak once reached an elevation of at least 15000 feet, and that it was then an active volcano with a summit crater filled with lava. It is thought that at a later period, the lava found distant means of escape, and that the support of the lava being withdrawn from the crater walls caused the summit portion of the mountain to sink in. That the summit was engulfed and not blown away by explosions is proved by the total absence of fragmental material on its slopes. That volcanic activity as resumed again later is recorded in the presence of Wizard Island, a secondary crater or cone, raised within the main cavity.

Climate

Climatic contrast.—The great belt of mountains thus produced is by far the most pronounced physiographic feature of both Washington and Oregon. Lying, as these mountains do, directly in the path of the prevailing westerly winds, they exert a powerful influence upon the climate of the region. Their eastern and western slopes, as well as the eastern and western divisions of the states through which they pass, differ widely in their general climatology, the eastern exhibiting an almost arid climate with extremes of temperature, while the western is wet and equable.

Precipitation.—The chief source of rainfall in the Pacific States is evaporation from the Pacific Ocean. As the moisture laden westerlies move eastward, they are forced upward along the western slopes of the Cascades, where the air is cooled, largely as a result of expansion. This increased cooling causes a gradual increase of precipitation along the western slopes. In the north, the annual precipitation increases gradually from 45″ near the base of the range to 100″ at the summit. In Oregon, increase is also noticeable, but it reaches little more than 50″, due to decrease in elevation. In descending the eastern slope, the air steadily advances into a region having greater capacity for moisture, and so condensation and precipitation decrease rapidly. In the Columbia Valley, east of the Cascades, the annual precipitation ranges between 10 and 15 inches. The following figures illustrate clearly this rapid diminution of precipitation eastward. At the Cascade Locks on the Columbia near the 122nd Meridian the rainfall is 80″; at Hood River (121°30′) it is 43″, while at the Dalles near the 121st Meridian it is only 16″.

Monthly distribution.—These rains are not evenly distributed throughout the year. 90% of the precipitation occurs during the eight months from October to May inclusive, leaving but 10% for the remaining 4 months. This is due to the fact that in summer the land is warmer than the ocean and the vapor is carried eastward over the mountains for lack of sufficient cooling to condense it. In winter on the other hand, the warm air is cooled quickly in traveling over the cold land mass and the moisture is precipitated.

Contrast in temperature east and west.—The eastern and western slopes also exhibit a marked diversity in temperature. The western slope enjoys the uniformity characteristic of a marine climate, interrupted only by occasional hot or cold winds from across the mountains. The winters are mild, due to the warm winds from the ocean and the heat emitted through the condensation of vapor. This is not true of the eastern slope, for here the climate is subject to sudden changes and to great extremes of temperature.

Resources and Industries

Forests

The main wealth of the Cascade Range lies in its forests. The mountains are included in what may be known as "The Great Forest Belt of the Pacific," which begins in southern California and extends northward to Alaska. It extends up the western slope of the Cascades to elevations of 6000 ft., in the northern and 7000 ft., in the southern part of the range. These forests are continuous through the lower passes far down the valleys on the eastern or sunny side of the mountains. Owing to the equable temperature and abundance of moisture, the densest forests and largest trees are found on the western slope. Below 4000 ft., where the soil covering is thick and exceedingly rich in vegetable mould or humus, and where the temperature is favorable, the trees are so close and the underbrush so dense that travel is well nigh impossible. As higher altitudes are reached, there is a gradual thinning out due to the slight depth of the soil cover and adverse climatic conditions. On the eastern slope, the stand of timber is not nearly so great owing to the lack of rainfall. For the same reason, the density of the forests also decreases southward.

Species.—These forests consist almost entirely of conifers. Owing to the wide range of latitude and altitude the species vary in different places. The western slope is occupied mainly by the red fir, hemlock, cedar, and spruce. Of these the red fir is by far the most prevalent, hemlock being the next most common. On the western slope, in lower latitudes, and on the entire eastern slope where there is a reduction in rainfall, the species are the same but percentages vary. Here the red fir forms but a small percentage of the forests, while the yellow pine, almost absent west of the summit, becomes the predominating species.

Uses of different species.—Of these trees, the fir is pre-eminently useful. It is of greater strength than any of the others and is, therefore, adapted to structural work of all kinds, while the variety of grains and the high finish of which it is capable makes it extremely desirable for the inside finishing of houses, etc. The yellow pine is used extensively in the construction of irrigation flumes and for the manufacture of fruit boxes and crates to supply the demands of the enormous fruit-growing industry of the region.

Logging.—Along low-lying areas, where access is comparatively easy, and along railroads and such streams as lend themselves to the transportation of

lumber, logging has been extensively carried on. Parts of the Cascade forests are, however, practically untouched, due to the lack of transportation facilities.

Forest reserves.—The national government has at length awakened to the economic importance of its forests. It has begun to appreciate that their chief value is not represented in the timber, but in the important relation they bear to the problem of irrigation; in their capacity to store and later distribute the waters, which would otherwise rush to the sea, laying waste the fertile uplands and slopes and destroying the rich bottom lands with floods. That it has entered actively upon the work of conservation in this region is indicated by the continuous belt of reserves found in the Cascade Range.

Agriculture and Fruit-raising

Owing to the extreme ruggedness and the dense forests of this physiographic province, agriculture cannot be carried on extensively, yet it has been practiced with great success in the rich, alluvial bottom lands found along the lower stretches of all the streams. The Yakima, Hood, Kittitas, Entiat and Chelan valleys have become renowned as fruit-raising centers.

Hood River Valley.—One of the best known of these is probably the Hood River Valley almost every acre of which is now in cultivation. The Hood River and its tributaries furnish the water necessary for irrigation and during the fruiting season water is supplied daily in order to force the plants to yield their fullest capacity.

Yakima Valley.—The richest agricultural district of the province is found along the Yakima and a number of the small streams tributary to it. Here the disintegration of the basalt has given rise to soil of wonderful depth and fertility. Through irrigation, this has made one of the most productive regions of the West. One of the largest irrigation projects, involving the irrigation of 100,000 acres of land, is located here. The valley has become famous particularly for its apples, peaches and grapes, although small fruits, vegetables, grains, hay, alfalfa and hops are also raised in great quantities.

Grazing

Grazing is confined chiefly to the open forests of the eastern portion of the range, where the slopes are covered with grass and nutritious forage plants. Succulent herbage is also found in the "burned areas." Cattle, and horses, but particularly sheep belonging to the farmers and ranchmen of neighboring lowlands are pastured here in summer. These sheep are wintered on the bunch grass plains, but as soon as spring comes thousands leave for the mountains, which are reached in early May. Here they remain until the latter part of September. While this sheep pasturing is exceedingly profitable in itself, it is ruinous to the forests and there is a conspicuous dearth of young trees wherever flocks have been summered. For this reason "herding" of sheep has been prohibited in parts of the forest reserves.

Quarries

The Cascade region is also rich in the possession of a variety of rocks suitable for building and monumental purposes. Many of these, however, are in inaccessible places. The only quarries opened thus far are in the immediate vicinity of the railroads. Marble is found in the Northern Cascades but owing to the lack of transportation facilities is little used. Sandstone of commercial value is found along the western border of the range. Valuable granite quarries are found in Washington along the Great Northern Railroad from Index to Leavenworth. Except for the finer varieties used in monumental work, these quarries have enjoyed a practical monopoly of the granite business in the Puget Sound region. Large quantities have here been used for street curbing, monument bases, foundation work for buildings and other purposes.

Mining

Coal.—Mining is rapidly becoming an important industry. The leading product thus far is coal. Coal-bearing rocks are known to occur in many places along the western slopes of the Cascade Mountains. Excellent coal has been found in the Mt. Baker and Hamilton districts near the international boundary. The largest and best coal mines of the province, however, are found east of the Cascades in the Roslyn and Clealum districts. This coal is bituminous, and the mines not only supply Eastern Washington, but a considerable quantity of the coal finds its way to Seattle where large coal bunkers have been built to take care of the export trade.

Metals.—In metal mining the province has barely made a start, but it may some day play an important part in this industry. Gold, silver, copper and lead have been discovered in various parts of the range especially in northern Washington, but owing to the isolation of these deposits, they are necessarily of slow development. With the building of railways into the mining districts this industry will no doubt develop.

Water Power

The factor that will no doubt figure most prominently in the industrial development of this region is the water power, which is greater, perhaps, than that of any other section of the United States. The streams of these mountains possess all the requisite properties for the production of power, an abundant and uniform flow of water and many falls.

The extremely heavy rains, together with the snow which accumulates to great depths during the winter and melts off gradually during the dry summer months, insure an almost uniform flow of water for the large number of streams that leave the crests. That the term "Cascades" is no misnomer, can be seen in the upper courses of all of the streams, for they abound in foaming cataracts and cascades, showing only here and there stretches of more quiet water.

At present, these streams are supplying power for street railways, for electric lighting and manufacturing purposes to the adjacent centers of popula-

tion. Outside the manufacture of lumber and timber products, manufacturing has not yet assumed great importance in this region. Of the 13,125,000 horse power available in the state of Washington only 38,000 horsepower has supplied public corporations; the remainder is undeveloped. The undeveloped power in Oregon is estimated at 3,317,000 horsepower. Considering the cheap power and the almost unlimited resources of forest, mine and soil, together with the new opportunities offered by the opening of the Panama Canal, these states will no doubt, in the near future, become manufacturing centers of considerable prominence.

Transportation

As has been noted, all resources of the Cascade Mountains are practically undeveloped because of the lack of transportation facilities. Yet rapid strides have been made in this direction within the past few decades. Several of the old immigrant roads have been placed in excellent condition. These are now used as wagon roads and are owned and controlled by corporations which exact toll from all travelers. One of these is the old Barlow Road, which leads across the mountains just south of Mt. Hood from the Williamette Valley to eastern Oregon, while another follows the Middle Fork of the Williamette River through most of its extent. In addition to these old roads new ones have been built at great expense. Among the best known are the Snoqualmie Pass Road of Washington, and the Williamette Valley and Cascade Mt. Toll Road which crosses the range at Lat. 44°30′. Another has been recently completed near the international boundary. From these main roads, numerous shorter wagon roads and trails follow the wider divides and the rivers into the heart of the range and are of great use to prospectors, foresters, cattle and sheep men and tourists.

Although the building of these roads has aided greatly in opening up the region, the development of its resources amounted to nothing until the coming of the railroad. Five lines now cross the range, the Great Northern, the Northern Pacific, the Chicago, Milwaukee and St. Paul, the Oregon and Washington R. R. and Navigation Co., and the Portland and Seattle R. R. A comparative study of the activities in the regions adjacent to these lines and the more isolated portions of the range suggests the progress that the building of proposed new lines will inaugurate.

The Association of American Geographers is almost the only geographical society in which membership is limited to technically-trained and scientifically-recognized professional geographers. Its membership is about one hundred. By co-operative arrangement its annual volume is sent to many members of the American Geographical Society in New York, and the monthly *Bulletin of the American Geographical Society* is sent to all members of the Association of American Geographers. The two societies hold a joint meeting every spring in New York City, and maintain a joint Research Committee.

LEST WE FORGET

By E. G. Lange
State Normal School, Whitewater, Wis.

THIS is a day when many subjects and activities are clamoring for the time of student and teacher. Each of the common school branches has something intrinsic to make it worth while. In recent years, especially, courses and subjects have been expanded and enriched for the purpose of making a stronger appeal to students. In high school and college these factors often determine interest to a considerable degree. In the common school, however, the enthusiasm of the teacher for the subject often determines to a large extent whether or not the pupils get much out of the work either in inspiration or knowledge.

Observation has led me to believe that teachers do the best teaching in the subjects about which they know much. When they attempt to teach things which are not clear in their own minds the results are pathetic. Before we can hope for much better results in common school geography teaching we must have enthusiasm for the subject, clear ideas regarding its subject matter, and a wide and intimate acquaintance with the spirit of the new science of geography.

The live teacher of geography in the grades should also be aware of several other important things. Of late the work of enriching subjects has been so assiduously carried on that school people have suddenly concluded that it is again time to apply the knife. Apparently we have been loading pupils with more subjects and at the same time have been adding more and richer stuff to each. All this work has been launched upon the pupil and he has been required to "take it" in the same or shorter time than formerly. This implies not only that pupils of today must have greater capacity but also that teachers must have more ability. Even idealists are now admitting that we have gotten ahead of ourselves in preparing mental rations for the boys and girls. Attempts to do too much have led to a rather thin veneer of knowledge and not much power. As all common school branches are receiving considerable attention with regard to the matter of elimination, so geography will certainly come in for its share of pruning. An interesting report along this line is Bulletin No. 51 (March, 1914) on the elimination of subject matter in elementary schools. It is issued by the Department of Public Instruction, St. Paul, Minnesota.

Occasionally we hear about "crying our own wares." There is plenty of evidence indicating that the geography people who know that there is a new science of modern geography, rich and worth while in content, will have to spread the knowledge of the new and better things in more places, if a wider influence is to be obtained. Certain it is that there are still many, many teachers who have a very imperfect concept of the modern science of geog-

raphy. Custom dies hard. So in our teaching we hold to many things which are no longer of much value in life. Go into our schools and observe the grade work in geography. Too many teachers are still teaching geography very much as it was taught them when they were in the grades. Often this is all the geography that the teacher knows. If the teacher is naturally bright the result is tolerable. Far too often, however, there is mere reading, naming, and memory cramming *and little else*. Emphasis on geographic principles and basal concepts; the evaluation of subject matter; the use of modern text books, supplementary materials, and experience, as sources from which to draw in solving problems; the real meaning of controls and responses; the use of manual exercises,—these and many other phases of work which geography should emphasize do not receive the attention they merit. It is my conviction that we geography teachers have here a problem which demands much more attention than it is receiving.

We may blame ourselves largely for the present state of affairs. We have not been brave enough in carrying the campaign for better things in geography to those who control and do the teaching. We have too long taken for granted that the people who come into our classes for a taste of the subject (and we may as well admit now that the amount of required work in geography will not be greatly increased in the near future), will in some miraculous way get more geographical knowledge and inspiration for themselves. This is likely to prove otherwise. Unless we send out these people with something very definite in subject matter, method, experience, *and especially a concrete, reliable, knowledge of sources from which they may continue to draw after they are out in the field at work,* it will prove true that they will have little enthusiasm for the new geography.

It seems especially desirable that we require more in the way of helpful books and periodicals which students should purchase for themselves. Right here is where our system of free text books in institutions makes for one weakness. *The students have too few good books and periodicals of their own when they go out into the field to teach.* Too often there is a limited supply in the school library. Think of the splendid articles and books that have recently appeared and which emphasize the essence of the new geography. Yet how many grade teachers own and use even a limited number of these good things? Such useful volumes on the teaching of geography as those by Sutherland, Dodge & Kirchwey, McMurry, Holtz, Charters and others, should be more largely owned and studied by those who wish to be qualified to teach geography in the schools of our land. How many take even one strictly geographical magazine or consult one regularly? To what extent do our teachers attempt to make a larger use of the almost limitless geographic material in the daily papers and standard magazines? To what extent do they make use of exhibit materials? Why not require that some of these good things become the property of those who expect to teach geography? Preachers, physicians, and lawyers very generally own libraries, why not more of this for grade

teachers? It has been held that it is unreasonable to ask professional students to buy books and magazines on geography because they cost money and because the vast majority of our teachers are only transients and will remain in the profession a very short time. Is this a very strong argument?

Just now the whole world is studying its geography lesson because conditions have made it desirable to know something about countries and people. What are our schools doing to make this more effective?

Lastly, if the leaders in geography do not believe in the subject with sufficient enthusiasm to keep pounding away, even more vigorously, for the rich new science of geography, we need not expect that better results will soon be produced in the school rooms where most people must continue to get much of the geography which they take into life.

ALUMINUM

By M. G. Edwards

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ALUMINUM is the most abundant and widely distributed metal in that portion of the earth available to observation. It is known to exist in over 200 different minerals and in practically all rocks. It forms twenty-one per cent of pure clay and one writer has estimated that in a cubic yard of clay there exists about 800 pounds of the metal. It is only within comparatively recent times that aluminum in its elemental state has ceased to attract wonder.

Properties.—Aluminum is a tin-white, lustrous metal resembling silver. It is malleable, ductile and sectile. It takes a brilliant polish and may be rolled or beaten into thin leaves. Cast in bell form its sound is short and sharp but in bar form it has a clear, resonant tone. It is a very good conductor of electricity and heat. It is not affected by hydrogen, nitrogen, sulphur or carbon and is scarcely attacked by nitric acid, but it is attacked by chlorine, fluorine, boron and iodine and is readily soluble in hydrochloric acid. It is the lightest of all useful metals, having a specific gravity of 2.58. Its tensile strength is about 35,000 pounds per square inch. It has a melting point of 657.3°C.

Ores of Aluminum.—Due to its great affinity for oxygen, aluminum does not exist in a free state in nature. Like iron, its most important ores are the oxides and hydrous oxides. Its sulphide is not found in a natural state. Only a few minerals have been employed for the production of the metal.

Kaolin ($Al_2O_3.2SiO_2.2H_2O$).—The cost of separation of the alumina from the silica in kaolin by any known process is at present prohibitive. It is probably only a matter of time before a process will be discovered for converting the extensive kaolin deposits into an important aluminum ore. The highly aluminous clays will then be particularly desirable.

Corundum (Al_2O_3).—Corundum is a comparatively rare mineral and is extremely hard. When broken it becomes too valuable as an abrasive to permit its use as an aluminum ore. Certain varieties of corundum are regarded as gems. Ruby is the red variety and sapphire is the blue.

Cryolite ($AlF_3.3NaF$).—Before the discovery of the bauxite deposits of the South cryolite was practically the only aluminum ore. This was brought from the southwestern coast of Greenland. It was first used by soap makers for its soda, and later used in making soda and aluminum salts and a white porcelain-like glass. The metallic aluminum derived from this source was expensive, as the metallurgical process used involved the use of metallic sodium. This in addition to the high cost entailed in importing the mineral caused an almost prohibitive price to be placed on the finished product. The Ivigtut cryolite was valued in 1912 at $80 per ton.

Bauxite ($Al_2O_3.2H_2O$).—Bauxite was discovered in 1821 by a chemist, Berthier, at the village of Baux, Bouches du Rhone, in southern France. These deposits were the first to be worked and from them the mineral receives its name. The deposits are about thirty feet thick and are associated with Cretaceous limestone, sandstones and clays which are distinctly stratified and are thought to represent products of a Cretaceous lake.

Bauxite occurs in many localities in Germany. At Vogelsburg the mineral occurs in masses, embedded in clay with which is associated masses of iron ore. It appears to be a direct residue from the decomposition of basalt. In Glenariff Valley, Ireland, the bauxite deposits are associated with volcanic rocks and are believed to be derived by the decomposition of rhyolite or rhyolite ash.

Bauxite was first discovered in America in 1887 near Rome, Georgia. This discovery was followed in 1891 by the discovery of the mineral in Alabama and Arkansas. The latter state is the greatest producer in the United States at the present time. The discovery of the New Mexico deposits followed in a few years but these deposits have never been worked because of their inaccessibility. They also appear to be derived from the decomposition of basic volcanic rock. Still later, bauxite in commercial quantities was found in Tennessee on the east side of Missionary Ridge, near Chattanooga. Active mining has been going on continuously for many years. No other deposits of commercial importance are at present known in the United States.

Alunite ($K_2O.3Al_2O_3.4SO_3.6H_2O$).—Recent studies of the alunite deposits of Marysville, Utah, Rosita Hills, Colorado, and of other western states by the United States Geological Survey indicate that alunite may become an important source of aluminum in the future. Although it has heretofore been regarded valuable as a source of potash, it should by no means be ignored as a possible source of aluminum.

Production.—The remarkable increase in the production of aluminum is shown by the following table which gives the production in pounds for every fifth year since the beginning of the industry in 1883.

1883	83 pounds
1888	19,000 pounds
1893	333,629 pounds
1898	5,200,000 pounds
1903	7,500,000 pounds
1908	11,152,000 pounds
1912	65,607,000 pounds

The total production between 1883 and 1912 was 305,358,779 pounds. The value of the domestic consumption of the metal in 1912 was $11,907,000. In the same year the value of the exports of aluminum and of the manufactures of aluminum was $1,347,621. In order to supply this rapidly increasing demand for the metal there was mined in the United States in 1912, 159,865 long tons of bauxite valued at $768,932.

Metallurgy.—In the early part of the nineteenth century, Oerstad suggested a process for obtaining the metal aluminum by treating the chloride with an alkali metal. This suggestion was adopted by Wohler in 1827 when he isolated aluminum for the first time and determined some of its physical properties. This process was later modified by Deville who in 1855 exhibited a bar of the "silver white metal made from clay" at the Paris Exposition. At the time it was considered one of the chemical wonders of the age. It sold for $15 an ounce.

The cost of the metal was rapidly reduced by improved metallurgical methods, so that in 1884 Colonel Frishmuth who cast the tip of the Washington Monument furnished the metal at $15 a pound.

Electrolytic processes were then devised of which the Cowles Brothers process, the Hall process and the Hiroult process were the most important for many years. Alfred H. Cowles has recently patented a process for the extraction of alumina from clay. In 1912 a process was patented for the extraction of alumina from silicates like the feldspars.

The manufacture of metallic aluminum as carried out at present by one of the largest companies is as follows: The aluminum is obtained from bauxite by dissolving the mineral in caustic soda and precipitating it by the addition of some previously precipitated alumina. The alumina is then filtered off, washed, dried, calcined and taken to the electric furnaces. The molten electrolyte consists of alumina and its flux, cryolite. Aluminum is reduced at the point of contact of the carbon anodes which oxidize and burn away, the gases going into the atmosphere. Hydrofluoric acid gas is evolved from the cryolite. The aluminum sinks to the bottom of the furnace and is tapped off.

Uses.—The first article ever to be manufactured from the pure aluminum was a rattle for the young Prince Imperial of France in 1856. At first it was confined largely to jewelry, medals, and inlaid work. On account of its extreme lightness it became valuable for sextants, eye-glasses and telescope tubes. It found a frequent use in the manufacture of delicate weights, fine wires,

and beams of balances. In 1862 culinary articles made from aluminum were displayed at the London exposition, but for practical use in the household the cost at that time was prohibitive.

Its days of limited usefulness are at an end. Today it finds a wide application in the arts and manufactures. It is extensively used in the purification of iron and steel. It is replacing copper and brass wherever lightness is a desirable feature, as in bed plates for torpedo boat engines, internal fixings for ships, motor car parts, and in chemical works. It is especially desirable in the manufacture of camp equipment where its lightness and non-corrosive qualities make it doubly valuable. For army use it has had a wide application in several countries along lines of marine engineering, as shells for cartridges, and in drum heads. European powers have equipped their soldiers with it in the present war wherever possible.

Aluminum is at present being used in the New York telephone and telegraph wires and giving satisfactory service under all weather conditions. In Chicago some of the electric lines are of aluminum and here again it has justified its use. The new transmission line which carries power to Los Angeles over a distance of 275 miles is of the same metal. Aluminum has an electrical conductivity double that of copper per pound.

Aluminum combines readily with a number of other metals to form a large series of useful alloys which gives it a still greater range of usefulness as it combines the lightness of aluminum with greater strength and hardness. The aluminum bronzes, composed of varying proportions of aluminum and copper are the most important of these alloys. One of the aluminum bronzes has a tensile strength as high as forty-one tons per square inch which makes it desirable for machinery, propeller blades, and for castings of heavy guns.

With the discovery of large deposits of rich aluminum ores and the perfection of metallurgical processes by which cheap extraction is possible on a commercial scale, the metal has ceased to be a chemical curiosity and is rapidly coming to be regarded as a household necessity.

SOME VALUABLE GOVERNMENT REPORTS

Special Consular Reports: "Australia"—No. 47; "The Railway Situation in China"—No. 48; "Cocoa Production and Trade"—No. 50; "New Zealand"—No. 57; "Russia"—No. 61. May be obtained by addressing the Bureau of Manufactures, Dept. of Commerce and Labor, Washington, D. C. The Bureau of Fisheries of the same department has issued "The Fisheries of Alaska" (Document No. 730), "The Fur-seal Fisheries of Alaska" (Document No. 735), "The Fisheries and Guano Industry of Peru" (No. 663), "Sponge Culture" No. 670), "The Fisheries of China" (No. 664), "The Fisheries of Japan" (No. 665).

A STUDY OF GEOGRAPHY IN NORMAL SCHOOLS*

IN order to make a comparative estimate of the geography offered in the public normal schools of our country, a study was made of the work in one hundred and forty-four schools of this class. . . . In the 144 schools studied, geography is offered in some form in 131, and is required in some quantity in 103. In 109 schools offering a two-year course beyond a high school, geography is required in varying amounts in 78. Of the 13 schools making no mention of geography five offer courses in geology, of which one offers eight courses in geology.

In the 109 normals offering geography in some form, no electives are offered in 55. The maximum requirement found was three courses, five hours each for a half year; the minimum was 30 hours and the average perhaps 100 hours. . . . The following table showing the offering in ten schools requiring high school graduation for admission to a two-year professional course will indicate the variety in the geography opportunities. The details here shown are taken at random . . . :

Amount of Required Geography	*Nature of Work Required*	*Geography Electives Offered*
1 term	Methods	Geography and physiography.
1 term	General geography, methods	North America, Eurasia, commercial geography
100 hours	Principles	Methods, local geography
0		Political and physical geography
¼ year	Physical geography	0
2 courses	Physical, economic and regional	Physiography, agricultural geography, principles, methods, Europe, economic geography, social and historical geography
16 weeks	General and physical	0
2 hours, ½ year	Not stated	Map drawing, methods, North America, regional geography, physiography, meteorology, economic geography, Europe
4 hours, 1 term	Physiography	General geography, social geography of North America, of South America, of Europe, state geography, commercial geography, geography and American history
0		Industrial geography, physiography

A summary of the work throughout the country indicates that the amount of training in geography is, in general, inadequate in quantity, and often in quality, as a preparation for teaching one of the five fundamental subjects in

*Abridged from a paper by Professor R. E. Dodge in the Teachers College Record, Mar. 1914.

the elementary schools, at least to one especially interested in geography. This inadequacy in quantity is recognized by many enthusiastic teachers of geography and by some administrative officers, but the interest in improvement is not general. . . .

From one of the more progressive normal schools of the country comes the statement that for high school graduates "one term of geography"—so called "review," is required. "This course combines the work of method and subject matter, dealing with the elements of geography, with which we spend the larger portion of the term. While our students come from high schools, about forty per cent of them have had no geography whatever beyond the seventh or eighth grade."

From one of the states most widely known and praised for its excellent work in normal school geography, some illuminating facts have recently been given as to the geography preparation at admission and at graduation from three large normal schools. Of 1678 high school graduates admitted to these three schools, 28 per cent had no geography in the high school, 34 had one-half year's work, 30 per cent had one year's work, and 8 per cent had one and one-half year's work. Of 648 graduates from these normal schools graduated with life certificates, 41 per cent had no geography work while in training, 42.3 per cent had one twelve-weeks term, 12.5 per cent had two terms of the same length, 2.3 per cent had three terms, 1.3 per cent had over three terms.

The general deficiency in geographic training of senior students in normal schools is recognized in many localities, but not generally so. One large normal now requires the passing with high standing of an examination in locative geography before admission to the senior year, thus indicating that others besides the geography specialist recognize the general need of a knowledge of the A B C's of ordinary school geography.

However unsatisfactory may be the time given to geography in normal schools, the use of the time available is even more discouraging when the field as a whole is viewed. Of the required courses in geography given in the schools studied, 38 are physiography, 9 are commercial geography, 66 are methods, 29 are "geography," 48 are regional geography and review, 5 are principles, 2 geography and history, 1 is map drawing, and 3 are geology. Or of the 200 courses in geography, 50 are high school in type, and 140 are either methods courses or regional courses. Of the latter, the larger number are merely review courses of elementary school geography, as the description of text-book used will indicate.

Of the elective courses offered in the two years' normal courses, numbering in all 162, 41 are physiography (5 advanced in type), 27 are commercial geography, 25 are methods, 9 are "geography," 6 are entitled principles, 6 are rural school geography, 42 are regional geography, largely review courses, 4 are geography and history and 2 are devoted to map drawing.

The emphasis is given in the large to a review of the elementary facts of geography which form the larger portion of elementary school courses, and to

methods of teaching in elementary schools. With this limited attention to geography in our normal schools, and with the work, except in a few shining instances, either high school physiography, methods or review of elementary texts, is it any wonder that geography is so widely considered merely a children's subject that has not grown up? In a few institutions slowly but surely increasing in number, specially trained teachers are giving work in geography of very superior quality. They are the beacons that are pointing the way to the more conservative schools on the one hand, and, on the other, to the newer institutions in which the requirements in education are so great that a serious study of the materials of the elementary subjects is impossible. . . .

The causes of these conditions are many. In the first place, educational theory and practice, as important to the prospective teacher as is the knowledge of materials, in many institutions are over emphasized, and little time is left for the study of so-called academic subjects, other than from the bread and butter point of view. In the second place, pupils who enter the normal schools from a high school course have, as a rule, no knowledge of geography beyond that gained in the sixth or seventh grade of the elementary schools. Elementary school geography is rightly, and probably will remain, largely regional geography with an increasing emphasis in the higher grades of causal regional geography, culminating in a study of the reasons for economic and social conditions. High school courses of study in geography are usually specialized courses in physical geography or physiography, or in commercial geography. Thus the geographic training of the prospective teacher, on admission to the normal school, has been away from the field of elementary geography, and the normal school teacher of geography must bridge the gap as effectively as his limited time will permit.

Three methods of procedure are possible. The easiest for the teacher not trained in higher geography, is to review the details of elementary school work, as is so frequently done. The pupil-teachers thus go out to their work with a preparation little beyond that of the uppils in the upper grades and rarely with any new point of view that will make it possible for them to vivify a subject deadened by a mass of detail. The margin of safety of the young teachers is slight, the ice is always thin, and they naturally expose themselves to the dangers of the subject as little as possible.

The second plan, the systematic, is to organize the normal school work so as to treat in turn the underlying principles of geography, some special continent from a causal standpoint, and methods of teaching geography in elementary schools. . . .

The revivification of school geography, long misunderstood and unappreciated because so largely devoted to detail in memorizing myriads of items, all of questionable permanent value, depends upon the right point of view on the part of the normal school teachers. If the best training in geography is that which gives the students the best knowledge of essentials, and the best power to organize and evaluate details, the method of study to be followed in

normal schools is that which will give the best outlook upon the field, and best awaken the mind of the pupil to the opportunities in geography and to its problems. . . .

GEOGRAPHICAL CONSIDERATIONS IN SELECTING THE SITE FOR THE NATIONAL CAPITAL

IN the opening chapter of his recent book, *A History of the National Capital* (Macmillan, 1914) Mr. W. B. Bryan says: "A vital consideration in selecting the location of the seat of government of the United States was convenience of access to all portions of the country. It was to be central as to population and territory. Moreover, it was to be on a navigable river connecting the Atlantic on the one side with the great western country on the other." Geographical considerations were the dominant ones all through the 10 year period of discussion and wire-pulling which culminated in the selection of the present site of Washington. The New England colonies and the colonies south of Virginia recognized that, on geographical grounds, they were ruled out. Each of the middle colonies strove energetically to persuade congress that it contained the one and only spot, predestined by nature for the National Capital.

Nine days after the preliminary articles of peace were signed in Paris, Kingston on the Hudson began a movement to have itself selected for the honor. A few months later, Annapolis, Md., proceeded to offer land to congress for a federal district. Within another month, the New Jersey legislature offered land and money for the same purpose, recommending a site at the head of navigation of the Delaware, near Trenton. Virginia quickly followed with an offer of the town of Williamsburg, including a gift of the then existing "palace," the capitol, all of the public buildings, 300 acres of land, and money not to exceed 100,000 pounds for the erection of thirteen hotels for the delegates in congress. Virginia also offered to unite with Maryland in ceding land on opposite sides of the Potomac. Congress, however, took no definite action for several years.

Throughout the protracted discussions, three conditions were always held to be essential: (1) the national capital must be geographically central; (2) it must be on a navigable river heading in the West; (3) it must not be near enough to the coast to be in danger of a sea attack.

The choice gradually settled down to possible sites on the Delaware, Susquehanna, and Potomac. At one time the plan of having two capitals, to be used alternately, was considered. Another plan was to place the federal district well up the Potomac in the narrow neck of Maryland, where it should be very near to both the Virginia and the Pennsylvania boundaries, thus satisfying the ambitions of three states. The formation of the Potomac Company for the purpose of improving the upper river for navigation tended to increase the claims of that river.

In 1789, the House of Representatives after prolonged debate, selected the falls of the Susquehanna as the site, but the Senate rejected it and voted for Germantown on the Delaware. In 1790 the Senate, by a vote of 14 to 12 and the house by a vote of 29 to 22, selected the Potomac, and specified that a site should be chosen somewhere between the East Branch (the southern boundary of the present city of Washington) and the Connogocheague, 67 miles up the Potomac. President Washington himself, after going over the entire ground and after receiving the petitions of the various rival towns within the limits, selected the Georgetown site, the present District of Columbia.

It is an interesting fact that two of the points most insisted upon—centrality, and position on a navigable river leading to the Atlantic and heading in the West—were advantages of only a temporary character, for the site soon ceased to be central, and the Potomac, as a navigable waterway to the West, was a commercial failure. R. H. W.

RECENT PUBLICATIONS

ATLAS DE LA PLUS GRANDE FRANCE; Geographique, Politique, Economique, Departmental. By Onesime Reclus. 160 colored plates, 160 pages of text. 70 francs, unbound. Attinger Freres, Publishers, Paris, 1914.

The material and organization of this atlas make it a model for use in regional geography. The plates and type pages are 8 by 11 inches. Each plate is provided with an adjoining page of explanatory text containing an average of three black-line diagrams or sketch maps.

The first twelve plates and pages of text are devoted to general considerations covering the distribution of French possessions and the climate, stream regimen, natural regions, geology, political divisions, social, economic, and military conditions of France.

Plates and pages 13 to 56 inclusive give a more detailed description of France based on ten somewhat arbitrarily chosen regions. Taking the "Central Region" as a type, one finds a topographic map (scale 1:1,500,000) with a page of text discussing the topography and geology, the climate, hydrography, population, and natural resources. For greater detail the region is then divided into a northern and a southern section. For each section is shown a map (scale 1:1,300,000) of agricultural and mineral production and one of industrial and commercial conditions. A page of appropriate discussion for each plate covers similar topics. Thus for this central region there are five plates and five pages of description.

Plates 57 to 143 inclusive are devoted to maps of the 87 "departments" of France. (Scale 1:500,000). These maps are sufficiently detailed to show not only the "Arrondissements" but the "Cantons." Light shading indicates the topography and appropriate symbols show the distribution of forests, the political status of the cities and villages, the ownership of the roads, and the relative importance of the railways. Tramways, canals, and navigable water-

ways are also indicated. Actual elevations in figures are placed at frequent intervals. The accompanying page of text treats the Department in each under the following headings: Geology and topography, Stream courses, Climate, Population, Administrative divisions, National defense, Justice, Public instruction, Religions, Agricultural and mineral products, Manufacturing industries, Commerce and Transportation routes. The emphasis is usually placed on the geology, topography, hydrology, productions, and industries. These descriptions are amplified by diagrams showing the percentage of population engaged in various occupations, the proportion of cultivated to pasture and forest land. Sketch maps and cross-sections showing local details of topography and geology and agronomy are numerous.

The atlas is complete in twenty sections, eighteen of which are now published. The two remaining sections, plates 145 to 160, are to cover the foreign possessions of France. They are withheld from publication until the close of the European war.

The engraving and coloring of the plates are admirable, as are the schemes for showing distribution and percentages. Adverse criticism must be limited to the statement that some of the maps, particularly those of production and industry for the ten regions, are made to show too much. It will doubtless be many years before anything of comparable excellence is published for the United States. V. C. FINCH.

ALASKAN GLACIER STUDIES, by Ralph S. Tarr and Lawrence Martin. Published by the National Geographic Society, Washington, D. C., 1914. $5.00.

Outside of the Polar regions, characterized especially by vast blanketing sheets of glacier ice, there is no region which can vie with Alaska either in the size or in the wide range of variety of its existing glaciers. The scientific exploitation of this field, it is pleasant to record, has been almost exclusively the work of American glacialists, who have thus added greatly to the world's knowledge of glacier phenomena. The National Geographic Society, which has largely financed the more recent glacial exploration of the region under the direction of Professors Tarr and Martin, is to be congratulated upon the appearance of a comprehensive report in which the scattered data from a number of preliminary and special studies have been brought together and supplemented by considerable new material. The volume is fully, though not sumptuously, illustrated, and the use of half-tone and the quality of paper and binding would indicate that it is designed for rather wide distribution rather than for the book collections of the dilettante. About one half the volume appears under the joint authorship and is devoted to the glaciers of the Yakutat Bay region at the base of Mount St. Elias, whereas the last twelve chapters have been prepared by the junior author since the much lamented death of Professor Tarr, and treat of the glaciers of Prince William Sound and the lower Copper River.

It is obviously beyond the limits of this review to attempt a summary of the contents of the volume, which to a large extent is given over to a discussion of glacier characteristics and the evidence of changes in the glacier fronts since they were first visited by travellers.

The classification which the authors adopt goes out from the idea that it is necessary to retain in scientific nomenclature all the individual names which have in the past been somewhat indiscriminately applied to different parts of the same glacier mass, even where one name may apply to the head and the other to the foot of the same stream. It does not seem likely that such a classification will long endure. One type which the authors first described from the Alaskan region, and which appears to have a wide application, is what they call the "through glacier"—a moving body of glacier ice which like a saddle crosses a divide to dissipators on either side. Another large contribution of the authors, though it has likewise found publication before, is the relation which they appear to have established between earthquakes and sporadic advances in the glacier fronts which are sudden and short-lived, and which are delayed by periods dependent upon the length of the glacier streams.

The volume contains in a pocket a map of Alaska showing the distribution of its glaciers, and a number of special maps which present the work of accurate surveys carried out in connection with the several expeditions. In addition to the specialist upon glaciers, the book will be widely read by those having interest in travel, and many will regard it as unfortunate that the book has not been given a somewhat more attractive dress. The frontispiece in particular might well have been reproduced in lithograph instead of by the cheaper and unsatisfactory half-tone. Notwithstanding shortcomings of this character the volume is a valuable one and one which must frequently be consulted by the student of glaciology. WM. HERBERT HOBBS.

THE GEOGRAPHER

THE geographer is expected to have more than a superficial acquaintance with most subjects and to be deeply versed in many. Tack the title geography onto any subject relating to man or the surface of the globe, and the unfortunate geographer is expected to be ready to expound it. Any aspect of knowledge is supposed thus to become a part of geographical study. Call astronomy astronomical geography and the geographer is at once expected to be versed in the relationships of bodies in space to one another; yet that is not geography, nor, to be precise, is surveying. The economist demands that the geographer shall be a student of the principles of economics and shall discuss tariffs and bounties and other man-made institutions, but that is not really the business of the geographer. Then, to crown all, the geographer is looked to for that anomalous subject known as historical geography, which is neither one thing nor another, but as expounded in most text-books is more history than geography, because it simply describes the place where certain events occurred. The geographer is not omniscient, and he has his limitations like most other people.—[R. N. R. Brown in *Scot. Geog. Mag.* Sept., '14.]

THE COLORADO GEOGRAPHIC SOCIETY

ON October 28, 1914, at the invitation of the Governor of Colorado, a convention of nearly a hundred of the state's representative citizens met in the Senate Chamber of the Capitol in Denver to consider ways and means of supervising and clarifying the geographical names of Colorado, of collecting and preserving the historical associations of towns, streams, mountains, highways, passes and other geographical features of the state, and of eliminating duplicate or otherwise undesirable names.

As a result of the convention, the Colorado Geographic Society was organized and a committee was left in charge of the details of organization. This committee has incorporated the Society, to which any reputable person interested is eligible. The government of the Society is vested in the Advisory Committee, now in process of formation, to consist of about thirty citizens representative of the various localities, and of the geographical interests of the state. The Advisory Committee selects, with the Governor's approval and designation, a group of five, to be known as the Colorado Geographic Board. This Board is the actual working arm of the Society; but all its findings are to be referred to the Advisory Committee. It is hoped thus to combine the efficiency of a small working body with the wisdom of a large representative one.

GEOLOGY AND GEOGRAPHY

PHYSICAL geology was born under the name of physical geography. The christening was unfortunate, for in those days geography was exactly what the derivation of the word suggests, a description of the earth, while the new subject was from the beginning strictly an interpretative one. However, the mistake was made, and physical geography, so called, is in consequence popularly looked on as within the province of the geographer. The development of the race is here comparable to that of the individual, insomuch as the most capable, perhaps the only really capable, exponent of that subject must be the geologist. The geologist, like every other scientist, has his definite outlook, which he is often unable and seldom willing to transgress. Consequently, though we find the geologist passing through physical geology to geography he stays his interpretation of nature on that plane. It is a perfectly intelligible outcome when the evolution of the subject is considered. Most geographers of this physical school reached their geography through a thorough steeping in geological science. Hence they see the world from a definite but purely physical standpoint and fail to give due recognition or prominence to non-physical or animate phenomena."—[R. N. R. Brown in *Scot. Geog. Mag.* Sept., 1914.]